Contract No. DE-FC22-90PC90548

Quarterly Report

No. 3

LIFAC Sorbent Injection Desulfurization Demonstration Project

Presented By

LIFAC NORTH AMERICA, INC.

A Joint Venture Between

ICF KAISER ENGINEERS

Four Gateway Center
Pittsburgh, Pennsylvania 15222

Tampella power

P.O. Box 626
SF-33101
Tampere, Finland

Presented To

U.S. Department of Energy

Pittsburgh Energy Technology Center
Pittsburgh, Pennsylvania 15236

April - June 1991

LIFAC SORBENT INJECTION
DESULFURIZATION DEMONSTRATION PROJECT

QUARTERLY REPORT NO. 3
APRIL - JUNE 1991

Submitted to

U. S. DEPARTMENT OF ENERGY

by

LIFAC NORTH AMERICA

LIFAC Sorbent Injection Desulfurization Demonstration Project

QUARTERLY REPORT NO. 3
APRIL - JUNE 1991

TABLE OF CONTENTS

INTRODUCTION

In December 1990, the U.S. Department of Energy selected 13 projects for funding under the Federal Clean Coal Technology Program (Round III). One of the projects selected was the project sponsored by LIFAC North America, (LIFAC NA), titled "LIFAC Sorbent Injection Desulfurization Demonstration Project." The host site for this $17 million, three-phase project is Richmond Power and Light's Whitewater Valley Unit No. 2 in Richmond, Indiana. The LIFAC technology uses upper-furnace limestone injection with patented humidification of the flue gas to remove 75-85% of the sulfur dioxide (SO_2) in the flue gas.

In November 1990, after a ten (10) month negotiation period, LIFAC NA and the U.S. DOE entered into a Cooperative Agreement for the design, construction, and demonstration of the LIFAC system. This report is the third Technical Progress Report covering the period April 1, 1991 through the end of June 1991. Due to the power plant's planned outage schedule, and the time needed for engineering, design and procurement of critical equipment, DOE and LIFAC NA agreed to execute the Design Phase of the project in August 1990, with DOE funding contingent upon final signing of the Cooperative Agreement.

BACKGROUND

Project Team

The LIFAC demonstration at Whitewater Valley Unit No. 2 is being conducted by LIFAC North America, a joint venture partnership between:

- <u>ICF Kaiser Engineers</u> - A U.S. company based in Oakland, California, and a subsidiary of ICF International (ICF) based in Fairfax, Virginia.

- <u>Tampella Power Corp.</u> - A U.S. subsidiary of a large diversified international company, Tampella Corp., based in Tampere, Finland and the original developer of the LIFAC technology.

LIFAC NA is responsible for the overall administration of the project and for providing the 50 percent matching funds. Except for project administration, however, most of the actual work is being performed by the two parent firms under service agreements with LIFAC NA. Both parent firms work closely with Richmond Power and Light and the other project team members, including ICF Resources, the Electric Power Research Institute (EPRI), Indiana Corporation for Science and Technology (ICS&T), Peabody Coal Company, and Black Beauty Coal Company. LIFAC NA is having ICF Kaiser Engineers manage the demonstration project out of its Pittsburgh office, which provides excellent access to the DOE representatives of the Pittsburgh Energy Technology Center. Figure 1 shows the management structure being used throughout the three phases of the project.

LIFAC NA administers the project through a Management Committee that decides the overall policies, budgets, and schedules. All funding sources, invoicing, and information flows to LIFAC NA where the managing partners ensure that the project, funding and expenditures are consistent and in-line with the established policies, budgets, schedules and procedures.

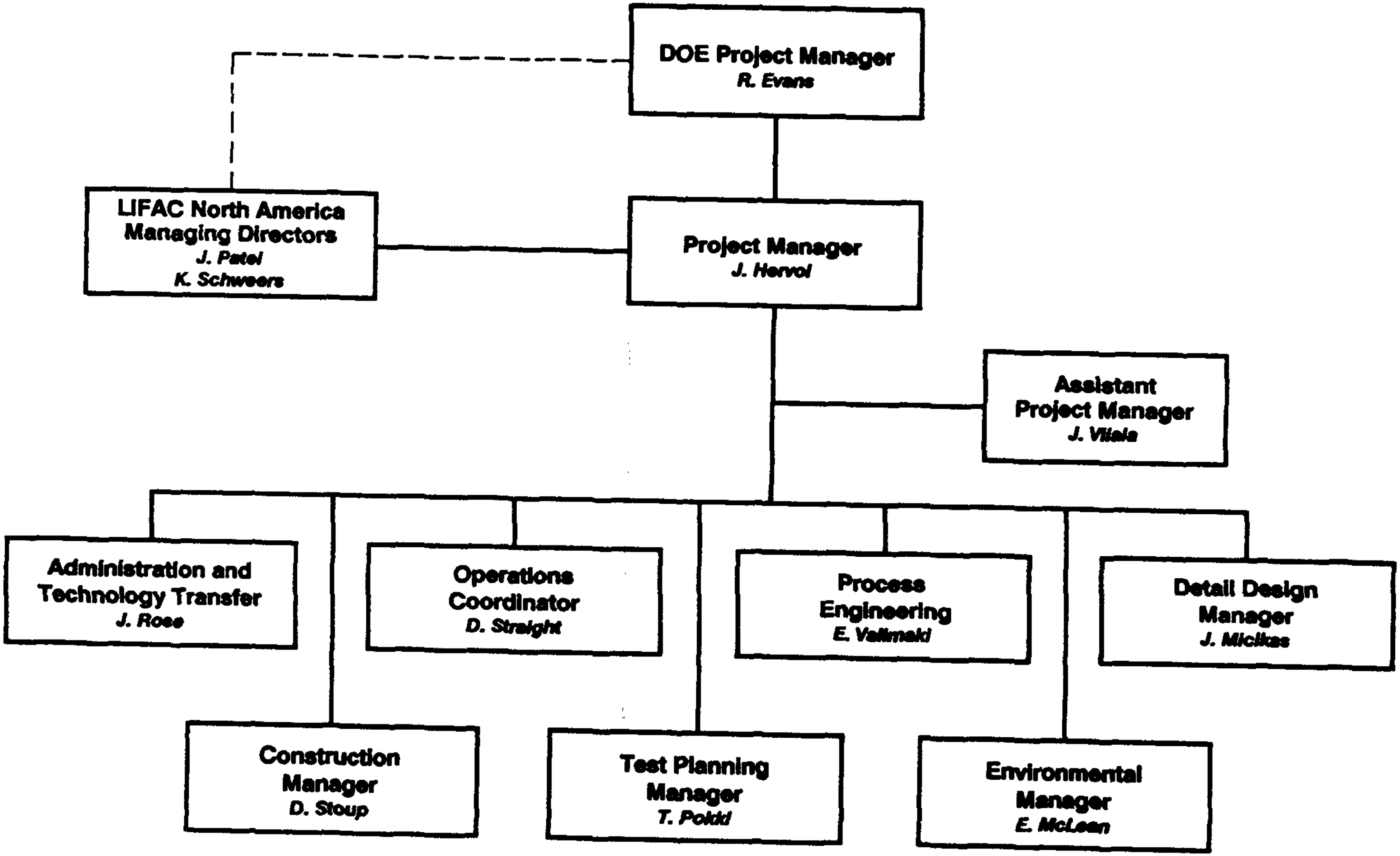
Process Development

In 1983, Finland enacted acid rain legislation which applied limits on SO_2 emissions sufficient to require that flue gas desulfurization systems have the capability to remove about eighty percent (80%) of the sulfur dioxide in the flue gas. This level could be met by conventional scrubbers, but could not be met by then available sorbent injection technology. Therefore, Tampella began developing an alternative system which resulted in the LIFAC process.

Initially, development included laboratory-scale and pilot-plant tests. Full-scale limestone injection tests were conducted at Tampella's Inkeroinen facility, a 160 Mwe coal-fired boiler using high-ash, low-sulfur Polish coal. At Ca:S ratios of 3:1, sulfur removal was less than 50%. Better results could have been attained using lime, but was rejected because the cost of lime is much higher than that of limestone.

In-house investigations by Tampella led to an alternative approach involving humidification in a separate vertical chamber which became known as the LIFAC Process. In cooperation with Pohjolan Voima Oy, a Finnish

Project Organization



utility, Tampella installed a full-scale limestone injection facility on a 220 Mwe coal-fired boiler located at Kristiinankaupunki. At this facility, a slipstream (5000 SCFM) containing the calcined limestone was used to test a small-scale activation reactor (2.5 MW) in which the gas was humidified. Reactor residence times of 3 to 12 seconds resulted in SO_2 removal rates up to 84%. Additional LIFAC pilot-scale tests were conducted at the 8 Mwe (thermal) level at the Neste Kulloo combustion laboratory to develop the relationships between the important operating and design parameters. Polish low-sulfur coal was burned to achieve 84% SO_2 removal.

In 1986, full-scale testing of LIFAC was conducted at Imatran Voima's Inkoo power plant on a 250 Mwe utility boiler. An activation chamber was built to treat a flue gas stream representing about 70 Mwe. Even though the boiler was 250 Mwe, the 70 Mwe stream represented about one-half of the flue gas feeding one of the plant's two EPS's (i.e., each ESP receives a 125 Mwe gas stream). This boiler used a 1.5% sulfur coal and sulfur removal was initially 61%. By late 1987, SO_2 removal rates had improved to 76%. In 1988, a LIFAC activation reactor was added to treat an additional 125 Mwe -- i.e., an entire flue gas/ESP stream-worth of flue gas from this same boiler. This newer activation reactor is achieving 75-80% SO_2 removal with Ca:S ratios between 2:1 and 2.5:1. In 1988, the first tests using high-sulfur U.S. coals were run at the pilot scale at the Neste Kulloo Research Center, using a Pittsburgh No. 8 coal containing 3% sulfur. SO_2 removal rates of 77% were achieved at a Ca:S ratio of 2:1.

This LIFAC demonstration project will be conducted on a 60 Mwe boiler burning high-sulfur U.S. coals to demonstrate the commercial application of the LIFAC process to U.S. utilities.

Process Description

LIFAC combines upper-furnace limestone injection followed by post-furnace humidification in an activation reactor located between the air preheater and the ESP. The process produces a dry and stable waste product that is partially removed from the bottom of the activation reactor and partially removed at the ESP.

Finely pulverized limestone is pneumatically conveyed and injected into the upper part of the boiler. Since the temperatures at the point of injection are in the range of 1800-2000° F, the limestone ($CaCO_3$) decomposes to form lime (CaO). As the lime passes through the furnace, initial desulfurization reactions take place. A portion of the SO_2 reacts with the CaO to form calcium sulfite ($CaSO_3$), part of which then oxidizes to form calcium sulfate ($CaSO_4$). Essentially all of the sulfur trioxide (SO_3) reacts with the CaO to form $CaSO_4$.

The flue gas and unreacted lime exit the boiler and pass through the air preheater. On leaving the air preheater, the gas/lime mixture is directed to the patented LIFAC activation reactor. In the reactor, additional sulfur dioxide capture occurs after the flue gas is humidified with a water spray. Humidification converts lime (CaO) to hydrated lime, $Ca(OH)_2$, which enhances further SO_2 removal. The activation reactor is designed to allow time for effective humidification of the flue gas, activation of the lime, and reaction of the SO_2 with the sorbent. All the water droplets evaporate before the flue gas leaves the activation reactor. The activation reactor is also designed specifically to minimize the potential for solids build-up on the walls of the chamber. The net effect is that at a Ca:S ratio in the range of 2:1 to 2.5:1, 70-80% of the SO_2 is removed from the flue gas.

The flue gas leaving the activation reactor then enters the existing ESP where the spent sorbent and fly ash are removed from the flue gas and sent to the disposal facilities. ESP effectiveness is also enhanced by the humidification of the flue gas. The solids collected by the ESP consist of fly ash, $CaCO_3$, $Ca(OH)_2$, CaO, $CaSO_4$, and $CaSO_3$. To improve utilization of the calcium, and increase SO_2 reduction to between 75 and 85%, a portion of the spent sorbent collected in the bottom of the activation reactor and/or in the ESP hoppers is recycled back into the ductwork just ahead of the activation reactor.

Process Advantages

The LIFAC technology has similarities to other sorbent injection technologies using humidification, but employs a unique patented vertical reaction chamber located down-stream of the boiler to facilitate and control the sulfur capture and other chemical reactions. This chamber improves the overall reaction efficiency enough to allow the use of pulverized limestone rather than more expensive reagents such as lime which are often used to increase the efficiency of other sorbent injection processes.

Sorbent injection is a potentially important alternative to conventional wet lime and limestone scrubbing, and this project is another effort to test alternative sorbent injection approaches. In comparison to wet systems, LIFAC, with recirculation of the sorbent, removes less sulfur dioxide - 75-85% relative to 90% or greater for conventional scrubbers - and requires more reagent material. However, if the demonstration is successful, LIFAC will offer these important advantages over wet scrubbing systems:

- LIFAC is relatively easy to retrofit to an existing boiler and requires less area than conventional wet FGD systems.

- LIFAC is less expensive to install than conventional wet FGD processes.

- LIFAC's overall costs measured on a dollar-per-ton SO_2 removed basis are less, an important advantage in a regulatory regime with trading of emission allocations.

- LIFAC produces a dry, readily disposable waste by-product versus a wet product.

- LIFAC is relatively simple to operate.

HOST SITE DESCRIPTION

The site for the LIFAC demonstration is Richmond Power and Light's Whitewater Valley 2 pulverized coal-fired power station (60 Mwe), located in Richmond, Indiana. Whitewater Valley 2, which began service in 1971, is a Combustion Engineering tangentially-fired boiler which uses high-sulfur bituminous coal from Western Indiana. Actual power generation produced by the unit approaches 65 megawatts. As such, it is one of the smallest existing, tangentially-fired units in the United States. The furnace is 26-feet, 11-inches deep and 24-feet, 8-inches wide. It has a primary and secondary superheater. Tube sizes and spacings are designed to achieve the highest possible heat-transfer rates with the least potential for gas-side fouling. The unit also has an inherent low draft-loss characteristic because of the lack of gas turns. At full load 540,000 lbs/hr. of steam are generated. The heat input at rated capacity is 651 x 10^6 Btu per hour. The design superheater outlet pressure and temperature are 1320 psi at 955°F. The unit has a horizontal shaft basket-type air preheater. The temperature leaving the economizer is about 645°F, while the flue gas temperature is about 316°F. The balanced-draft unit has 12 burners.

In 1980 the unit was fitted and fully optimized with a state-of-the-art Low-NO_x Concentric Firing System (LNCFS). The LNCFS represents a very cost effective means of reducing NO_x emissions in comparison with other retrofit possibilities. The system works on the principal of directing secondary air along the sides of the furnace and creating a fuel rich zone in the center of the furnace. With the LNCFS, the excess air can be maintained below 20 percent. Additionally, the installation reduces ash accumulation on the furnace walls increasing heat absorption and reducing attemperation requirements. With the LNCFS, each corner of the furnace has a tangential windbox consisting of three coal compartments and four auxiliary air compartments. At full load with all three 593 RB pulverizers operating, primary transport air from the pulverizers amounts to 23 percent of the total combustion air. Pulverizer capacity is 26,400 lbs/hr. with 52 grind coal and 70 percent minus 200 mesh.

Whitewater Unit 2 has a Lodge Cottrell cold side precipitator which was erected with the boiler. The precipitator treats 227,000 actual cubic feet per minute of 316°F flue gas with 45,000 square feet of collection area. The unit has two mechanical fields and four electrical fields and achieves 99 percent removal efficiency (from 3.9 gr/ft^3 to 0.04 gr/ft^3). The ESP performance was optimized by Lodge Cottrell when Richmond Power and Light purchased new controllers in 1985.

Whitewater Valley Unit 2's overall efficiency of 87.47 percent at full load has shown little variation over the years. The unit's average heat rate is 10,280 Btu/Kwh. At 60 percent of full load, the unit's efficiency increases to 88.17 percent. The unit uses approximately 0.935 pounds of coal per Kwh and generates 8.51 pounds of steam per Kwh.

The primary emissions monitored at the station are SO_2 and opacity. SO_2 emissions are calculated based on the coal analysis and are limited to 6 lbs/10^6 Btu. Opacity is monitored using an in-situ meter at the ESP outlet and is currently limited to 40 percent. Current SO_2 emissions for the unit are approximately 4 lbs/10^6 Btu, while opacity at full load ranges from 15 to 20 percent. Opacity at low load (40MW) ranges from 3 to 5 percent. Limited testing was conducted in November of 1986 for NO_x emissions. Results from the test work indicated that NO_x emissions averaged 0.65 lbs/10^6 Btu.

Whitewater Valley 2 has several important qualities as a LIFAC demonstration site. One of these is that Whitewater Valley 2 was the site of a prior joint EPA/EPRI demonstration of LIMB sorbent injection technology. Much of the sorbent injection equipment remains on site and will be used in the LIFAC demonstration, if possible. Another advantage of the site is that Whitewater Valley 2 is a challenging candidate for a retrofit due to the cramped conditions at the site. The plant is thus typical of many U.S. power plants which are potential sites for application of LIFAC. In addition, Whitewater Valley 2 boiler is small relative to its capacity; hence, it has high-temperature profiles relative to other boilers. This situation will require sorbent injection at higher points in the furnace in order to prevent deadburning of the reagent and may decrease residence times needed for sulfur removal. Whitewater Valley 2 will show LIFAC's performance under operational conditions most typical of U.S. power plants. The project will demonstrate LIFAC on high-sulfur U.S. coals and is a logical extension of the Finnish demonstration work and important for LIFAC's commercial success in the U.S.

PROJECT SCHEDULE

To demonstrate the technical viability of the LIFAC process to economically reduce sulfur emissions from the Whitewater Valley Unit No. 2, LIFAC NA is conducting a three-phase project.

Phase I: Design
Phase IIA: Long Lead Procurement
Phase IIB: Construction
Phase III: Operations

Except Phase IIA, each phase is comprised of three (3) tasks, a management and administration task, a technical task and an environmental task. The design phase began on August 8, 1990 and was scheduled to last six (6) months. Phase IIA, long lead procurement, overlaps the design phase and was expected to require about four (4) months to complete. The construction phase was then to continue for another seven (7) months, while the operations phase was scheduled to last about twenty-six (26) months. Figure 2 shows the original estimated project schedule which is based on a August 8, 1990 start date and a planned outage of Whitewater Valley 2 during March 1991.

It is during this outage that all the tie-ins and modifications to existing Unit No. 2 equipment were made. This required that the construction phase begin in early February, 1991 -- construction and start-up were to be completed by the end of August 1991. Operations and testing were to begin in September 1991 and continue for 26 months. However, during the last two reporting periods, the project encountered delays in the engineering and design task. These delays, along with some design changes, required that the Design Phase be extended by about seven months. Therefore, construction and start-up will not be completed until the end of January 1992. This represents a five-month slip in the overall schedule. Figure 3 shows the revised project schedule. Total project duration will now be 44 months.

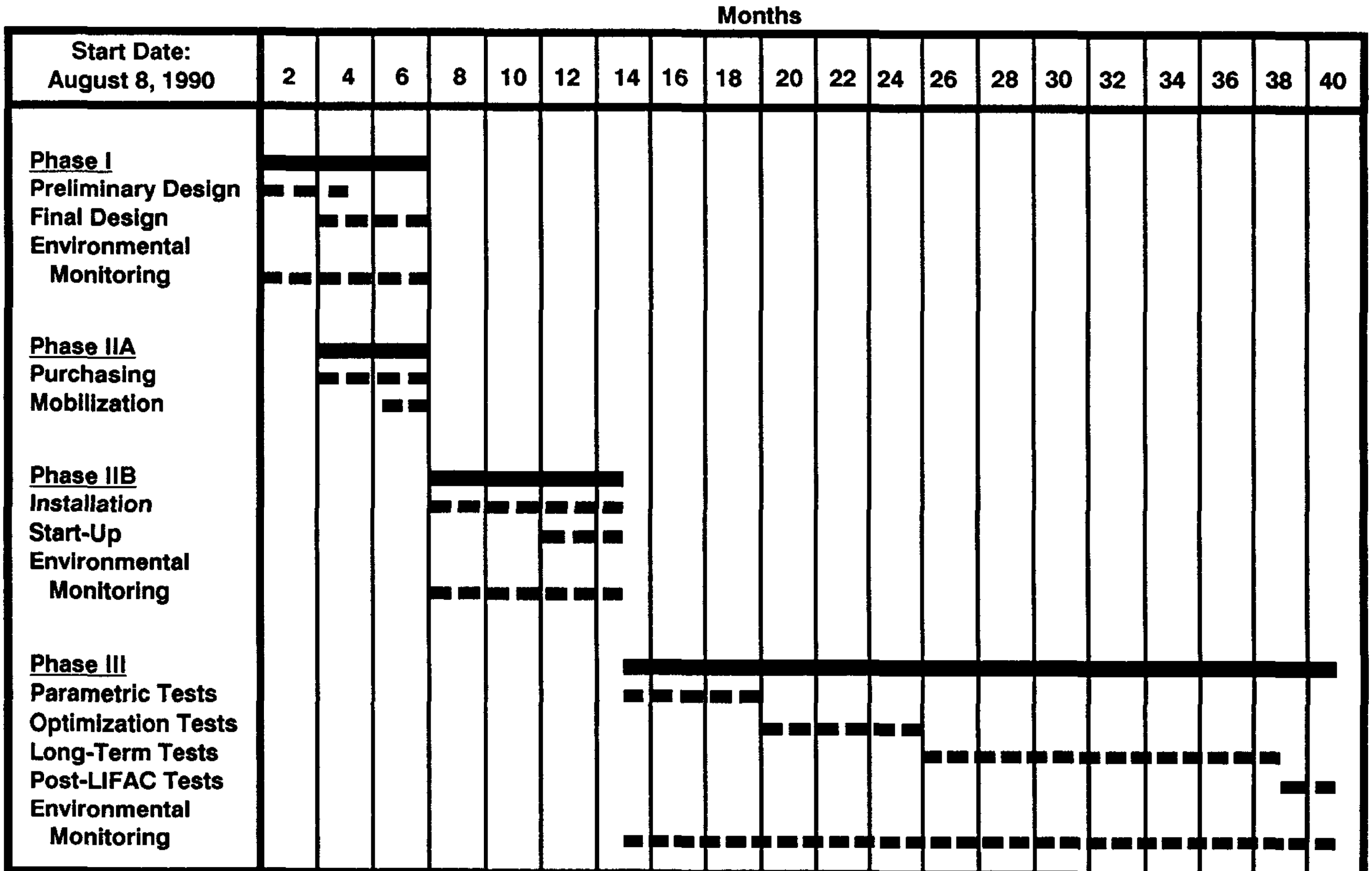
TECHNICAL PROGRESS

The work performed during this period (April - June 1991) was consistent with the Statement of Work contained in the Cooperative Agreement. During

LIFAC

LIFAC Demonstration

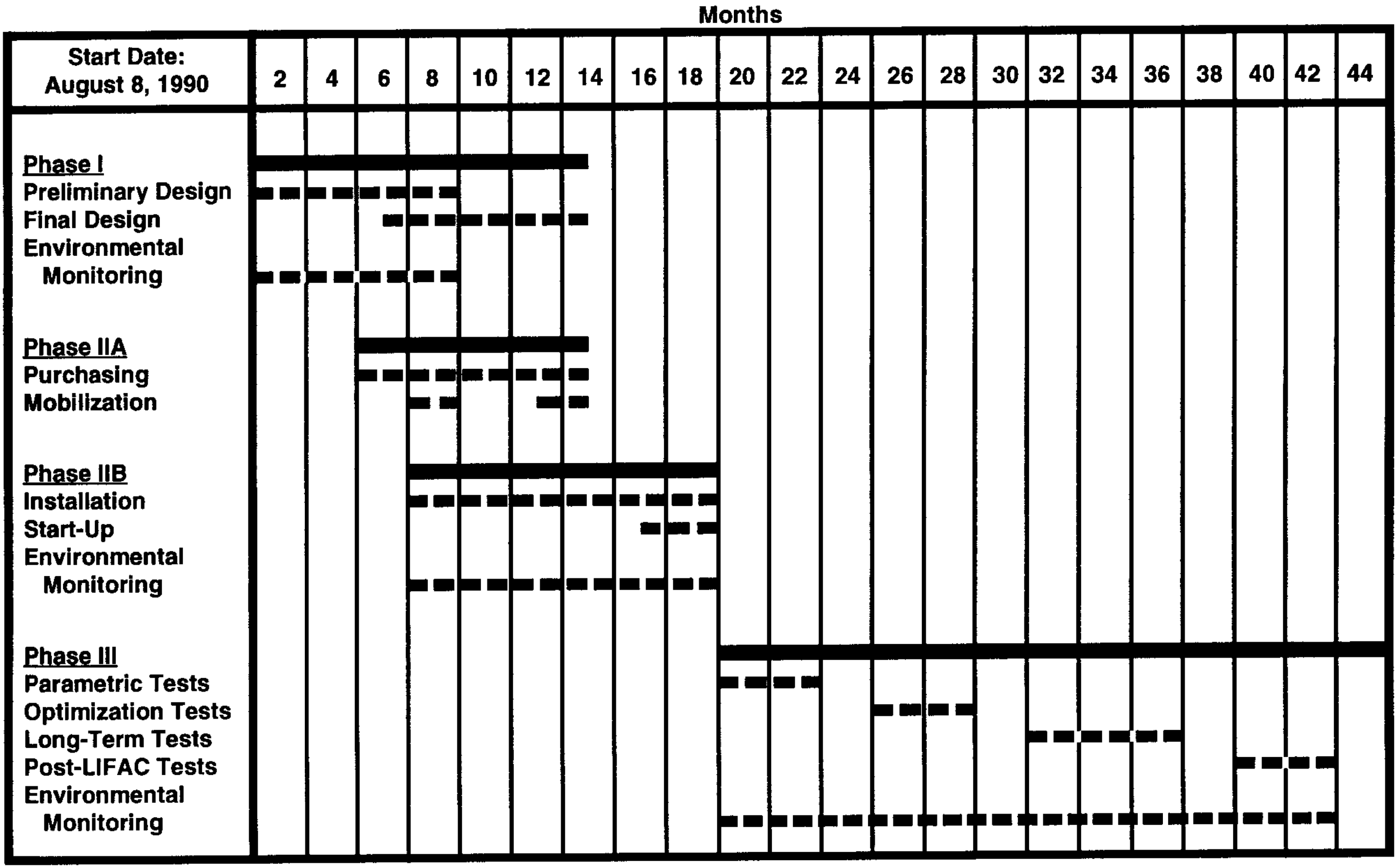
Original Project Schedule



LIFAC

LIFAC Demonstration

Revised Project Schedule



this period, emphasis was placed on five separate tasks. In the Design Phase, work continued on the Engineering and Design task. In the Construction Phase, work continued on all four tasks including Project Management, Long Lead Procurement, Installation and Start-up, and Environmental Monitoring. Following is a summary of the work performed under these tasks.

Project Management (WBS 1.2.1B)

During the April through June period, management efforts and achievements included:

- **Finalizing Partnership Agreements** - Tampella Power Corporation and ICF Kaiser Engineers resolved and signed all documents pertinent to the establishment of the joint venture including: marketing, partnership and technology licensing agreements.

- **Establishment of the LIFAC Management Committee** - In May, the LIFAC management committee began to conduct formal monthly meetings and established LIFAC NA procedures and policies. During these meetings all aspects of the LIFAC demonstration were reviewed and all necessary decisions related to the implementation of the DOE Cooperative Agreement were taken. In prior months, LIFAC management committee meetings were held and decisions taken, but they were less formal. The first meeting was held in Pittsburgh at ICF Kaiser Engineers offices and the second meeting was held in June at the Atlanta offices of Tampella Power.

- **Ground-Breaking Ceremony** - A very successful ground-breaking ceremony was held at the host site May 29, 1991.

- **Joint LIFAC NA/DOE Cooperation** - LIFAC NA took many steps towards full implementation of the Cooperative Agreement including:

  - Conducted the second quarterly project review meeting in Richmond, Indiana on the morning before the official ground-breaking ceremony.

- Met with DOE at PETC headquarters to discuss the performance review report of Grant Thornton. Final comments on the final report are expected to be supplied to DOE in the next reporting period. Many of the suggested management and accounting changes have already been implemented (e.g. formal management committee meetings).

- A new management plan is expected to be delivered to DOE in the next reporting period. The impetus for this revision is the progress and experience on the project so far as well as the Grant Thornton review.

- Provided DOE all required financial, project and cost reports including cost plan, monthly technical progress, cost management, federal assistance management summary and milestone-related reports. These reports met all DOE specifications related to committed costs.

- LIFAC NA sent additional invoices to DOE, and began to establish LIFAC NA accounting procedures consistent with DOE requirements that invoiced costs be presented on a phase-by-phase basis.

- Resolved the Tampella invoicing problem and LIFAC NA has been invoiced by Tampella through April.

- Signed first tier LIFAC NA subcontracts for Tampella Power Corporation, ICF Resources, ICF Kaiser Engineers, and Richmond Power and Light.

• **Regulatory** - Continued efforts to obtain all necessary state permits and approvals:

- An exemption to the state requirement for a Certificate of Need and Necessity was obtained from the Indiana Utility Regulatory Commission under the state's Clean Coal Project law. Under the exemption, the state of Indiana must be regularly updated on the demonstration; this has been implemented.

- Conducted meetings with Indiana Department of Environmental Management officials to outline steps related to a solid waste disposal permit (see environmental discussion elsewhere).

• **Funding Agreements** - Continued efforts to negotiate and finalize arrangements for participation/funding of other project participants:

  - Electric Power Research Institute - A draft report on the market potential for LIFAC among EPRI members was written and provided to EPRI, as per EPRI's request. LIFAC NA managers met in Richmond, Indiana with several representatives of EPRI to discuss EPRI funding. More information of the level of funding and technical assistance is expected in the next reporting period.

  - Indiana Corporation for Science and Technology (CST) - CST earlier announced its intention to award LIFAC NA 0.8 million dollars. LIFAC NA met with CST representatives in Indianapolis, Indiana and exchanged draft contracts in Indianapolis. Expect to sign a contract with CST for the full provision of the funding in next reporting period.

  - Peabody Coal Company - Conducted preliminary negotiations with Peabody Coal Company on contracts for the provision of coals during the test program. A formal response is expected from them by the beginning of the next reporting period.

  - Black Beauty Coal Company - Met with and conducted negotiations with Black Beauty on contracts for the provision of coals during the test program. Black Beauty indicated their willingness to participate and offered specific high sulfur coals. LIFAC NA is optimistic that contract negotiations will be successful.

- Lafarge/Limestone Company - In the last period, Lafarge informed LIFAC NA that it would not be able to participate in the funding of the project due to recent financial difficulties. Lafarge, however, did indicate interest in potentially participating in the project's tests of uses for the waste and study and characterization of the waste by-product. This decision was regrettable, but in no way jeopardizes the project since the partners are capable and committed to purchasing the services and materials Lafarge was to provide.

  In the period, LIFAC arranged meetings with three other limestone companies to discuss their participation on the project: (1) Mulzer, (2) Rodgers, and (3) Kosmos Cement - Southdown Corporation. Kosmos has preliminarily indicated an interest in participating and is investigating the possibility of supplying pulverized limestone from their Dayton, Ohio cement works. We are optimistic that an arrangement can be negotiated where Southdown provides the limestone and partially contributes to the project to defray the costs of transportation.

- **Technology Transfer Activities** - Undertook technology transfer activities including preliminary planning for a ground-breaking ceremony (see above), participation in several conferences, answering technical questions, etc.

- **Management Oversight** - LIFAC NA maintained close oversight of design and construction activities conducted during the planned maintenance outage at the Whitewater Valley Unit #2 site. Key issues discussed extensively at LIFAC NA management committee meetings included schedule, subcontract and equipment bids, budget, and status of design.

- **Scope Issue: Recycle** - LIFAC NA also discussed recent tests of recycling LIFAC wastes and whether such a system should be used in this Clean Coal Demonstration Project.

Engineering and Design (WBS 1.1.2)

During this period, emphasis was placed on the completion of many of the design activities for the Phase II construction portion of the project. This involved layout and design of the limestone storage area, reactor, reactor enclosure, stair tower, electrical rooms, piping systems and all the mechanical items included in these areas. In addition to this work, Tampella revised the layout and concept of the activation reactor humidification section. They delivered to ICF KE in June preliminary sketches of the new humidification section, injection nozzles, penthouse and ductwork arrangements. The mechanical and vessel departments began to lay out new general arrangements with Tampella's assistance.

Engineering and design activities included:

- Civil/Structural/Architectural design emphasis included:
  - Completion of foundations for the Limestone/MCC/VFD Building, Stair Tower, Reactor Support Structure, and Electrical Equipment Room.
  - Completion of foundation pile design and layout for the Reactor Support Structure and Stair Tower.
  - Completion of structural steel design for the Limestone/MCC/VFD Building, Secondary Air Blower floor steel framing, Reactor Support Structure, Stair Tower, Flue Gas Ductwork System, Electrical Equipment Building, ESP Ash Blower/Feeder support steel, Reactor Platforms and Reactor Penthouse (later deleted).
  - Layout and preliminary design of Splitter Support Platform and Splitter Support.
  - Layout and preliminary design of structural steel, foundations and architectural requirements for the Reactor Enclosure building.
  - Layout and preliminary design of ductwork supports off the Reactor Enclosure Building.
  - Wrote various civil/structural specifications.
  - Evaluated bids for the installation of piles and foundations.

- Mechanical design emphasis included:
  - Completion of the mechanical arrangement of the Limestone Storage Building.
  - Completion of the Limestone Silo Arrangement System.

- Completion of the Limestone Injection System.
- Completion of the arrangement and installation of the boiler injection ports.
- Completion of ductwork expansion joints.
- Completion of the Reactor Discharge Equipment.
- Completion of the Spent Sorbent Recirculation System.
- Evaluated bids for the Sorbent Injection/Secondary Air System, Reactor Vibrators and Reactor Discharge equipment.
- Work continued on the completion of Process Flow Diagrams.
- Layout of the revised Reactor top (including penthouse, injection nozzles, air and water piping, ductwork arrangement and vessel change).
- Wrote various mechanical equipment/system specifications and completed others started during the last reporting period.

• HVAC design emphasis included:

  - Completion of the design of heating, ventilation and air conditioning requirements of the Limestone Storage Building, Motor Control Center, Variable Frequency Drive Room and the Electrical Equipment Room.
  - Completion of the heating requirements for the reactor penthouse (later deleted).
  - Determination of the heating and ventilation requirements of the Reactor Enclosure Building.
  - Wrote HVAC specification.

• Piping/Vessel design emphasis included:

  - Completion of the Activation Reactor.
  - Completion of the Limestone Silo.
  - Completion of the ESP Ash Surge Hopper.
  - Completion of standard pipe supports.
  - Completion of arrangement and design of the following systems:

    - Limestone storage service air piping

  - Secondary air and limestone pneumatic transport piping
  - Spray water, compressed air, slag recycle and spent sorbent recycle systems
  - Steam and condensate piping
  - ESP ash recovery piping

- Completed steam flow balance and steam/condensate flow diagrams.
- Completed calculations for Secondary Air Blower requirements, compressed air requirements, spray water requirements and steam/condensate requirements.
- Wrote various piping/vessels specifications in addition to completing those started during the last report period.

• Electrical design emphasis included:

- Completion of lighting schedule, notes details and legend.
- Completion of reactor platform lighting and grounding.
- Engineering of single line diagrams, conduit plans, lighting schedules, conduit and cable schedules and grounding plans continued.
- Engineering of general plant lighting, powerhouse conduit plan, control room conduit layout, electrical panel schedules, elementary diagrams and interconnection diagrams.
- Layout and design of Limestone Storage Area embedded and exposed conduit plans, general arrangement of room lighting and grounding.
- Layout and design of Activation Reactor Area and building conduit plans, general arrangement, electrical equipment layout and lighting plans.
- Layout and design of spent sorbent area conduit plan.
- Layout and design of miscellaneous area conduit plans.
- Wrote electrical construction specification.
- Evaluated various electrical equipment bids.

• Instrumentation design emphasis included:

- Completion of legends and notes.
- Completion of P&ID's.

- Completion of instrumentation installation details.
- Development of loop diagrams, Automated Process Control System I/O Panel (digital and analog) Schematics.
- Wrote various equipment/instrumentation specifications in addition to completing those started during the last reporting period.

- Specifications required for the purchase of various equipment and systems were written by the mechanical, HVAC and instrumentation groups in addition to specifications required for construction by the civil/structural, mechanical and electrical groups. The following is a list of specifications written and completed during this period:

  - Pneumatic Vibrators
  - Flue Gas Reheaters
  - Reactor Ductwork Expansion Joints
  - Pneumatic Conveying
  - Secondary Air Blower/Fan
  - Spent Sorbent Recycle
  - Heating, Ventilating, Air Conditioning and Related Equipment
  - Flue Gas Analyzers
  - Piping Line Designation Tables
  - Electrical Construction
  - Insulation of Activation Reactor, Slag Crusher Conveyors, Flue Gas Ductwork, ESP Ash Surge Tank and assorted piping
  - Installation, testing and inspection of Rolled Steel H-Piling System and Concrete Foundations
  - General Construction/Installation - Phase II
  - Instrumentation Installation

ICF KE continued development of the process control system for LIFAC. Tampella's engineers continue to assist in providing the control logic and interlocking descriptions.

Long Lead Procurement (WBS 1.2.1A)

During this period, bid specifications were issued for all remaining long lead items. These included:

- Secondary air fan
- Flue gas reheaters
- Reactor fabrication and erection
- Sorbent recycle system
- Motor control centers
- Flue gas analyzers
- Expansion joints

During this period, purchase orders/subcontracts were issued for these items/activities:

- Reactor slag discharge system
- Transformers
- Secondary air fan
- Motor control centers
- Flue gas reheaters
- Reactor fabrication and erection
- Limestone storage bin

During the next reporting period, all remaining long lead procurement activities will be completed.

Installation and Startup (WBS 1.2.2B)
During April and May, all tie-in requirements were completed. This included finish painting of all new structural steel, installation of new floor grating and handrail and toeplate. Also, all insulation and cladding was completed on the new ductwork sections.

Also, during this reporting period, RP&L began installation of a new air compressor to provide instrument air to LIFAC equipment and to the new dry ash handling system that will be installed during the next reporting period.

Detailed drawings and plans were assembled as part of the Construction Permit Application for submittal to Indiana Department of Environmental Management.

Environmental Monitoring (WBS 1.2.3B)
Environmental activities during this quarter involved revising the draft EMP in conjunction with the development of the LIFAC system design and control system monitoring requirements. Meetings were held during system design to discuss process control monitoring and monitoring locations to clarify availability of

monitoring locations and the intersection of test plan, process control, and environmental monitoring requirements.

A second draft EMP was prepared and submitted to DOE for review. The second draft clarified the integration of the monitoring program with the design. Internal comments were requested from DOE personnel prior to submittal of the final EMP.

Meetings were held with staff members of Indiana Department of Environmental Management to discuss the status of RP&L's operating permit for particulate emissions and the potential problems that may exist when LIFAC generated ash is disposed of in landfills. LIFAC agreed to provide exothermic data to IDEM during the next reporting period to demonstrate that LIFAC generated ash will not cause any heating problems.

FUTURE PLANS

During the next period, LIFAC NA hopes to conclude negotiations and secure funding from the identified co-funders. This includes finding a replacement for LaFarge.

Meetings will be held with various regulatory agencies in hopes of obtaining all the necessary permits or variances needed to install and operate LIFAC at Richmond Power & Light. Submit the formal construction permit application to IDEM for approval. Submit formal variance request for higher particulate emissions during normal operation of the plant and when LIFAC is in operation.

Complete all detailed design and procurement of equipment needed for installation of LIFAC and issue all the required purchase orders and subcontracts needed to complete construction and startup by the end of January 1992.

Complete the final draft of the EMP and submit it to DOE for review and comment.

Submit for a no-cost time extension to cover the five (5) month delay encountered during the Design Phase.

Submit LIFAC ash exothermic data to IDEM for review and comment.